MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

EOP3036 FABRICATION AND PACKAGING TECHNOLOGY

(OPE)

12 MARCH 2019
2:30 P.M - 4:30 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages including cover page with FOUR questions.
2. Attempt **ALL** questions and the distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) In the Czochralski growth technique, the initial concentration of phosphorus in silicon molten is 5×10^{18} cm^{-3} and the segregation coefficient of phosphorus is 0.35.

(i) Calculate the concentration of phosphorus in the silicon ingot after 50% growth.

[4 marks]

(ii) Calculate the resistivity of the silicon wafer produced from the silicon ingot when the mobility is measured to be 750 $cm^2V^{-1}s^{-1}$.

[4 marks]

(b) Describe how multiple epitaxial layers could be grown by using liquid phase epitaxy (LPE) technique.

[7 marks]

(c) Metallisation is a process used to deposit metal contacts or interconnects on semiconductor wafer. With the aid of a clearly labelled diagram, describe how metallisation is carried out using thermal evaporation technique.

[3+7=10 marks]

Question 2

(a) What are the advantages and disadvantages of proximity and projection mask aligners?

[4 marks]

(b) The specifications of a proximity mask aligner are given in the **Table 2(b)**.

Table 2(b)

Parameter	Value
Light wavelength [nm]	436
Distance between the mask aperture and wafer [μm]	2
Constant k	0.9

Justify if the mask aligner is suitable to be used for patterning features with size smaller than 0.5 μm on a semiconductor wafer.

[3 marks]

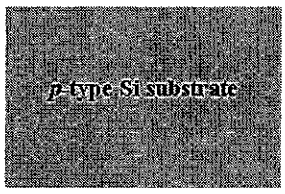
(c) Describe how active and passive alignment methods are implemented in coupling of a laser diode with an optical fibre.

[2+2=4 marks]

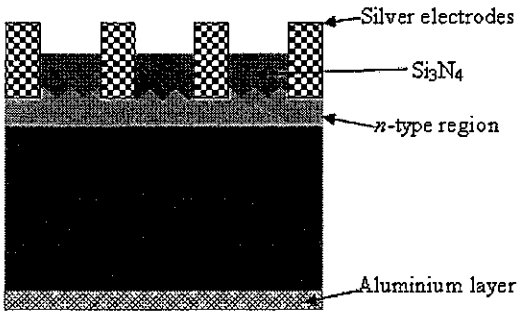
Continued.....

(d) As a process engineer working in a solar cell company, you are assigned to design the fabrication processes to produce silicon solar cells from a p-type silicon wafer as shown in the **Fig. 2(d)**. With the aid of a series of clearly labelled sketches, design the fabrication processes required to produce silicon solar cells and provide a brief description at every fabrication step.

[7×2=14 marks]



p-type silicon wafer



Final solar cell structure

Fig. 2(d)

Question 3

ZNT Fibre Limited is specialised in making high quality optical fibres for communication applications. A client has requested an order for optical fibre that is suitable for very long-haul communication system. As a R&D engineer, you are assigned to provide technical support to the client.

(a) Justify whether **step-index single mode optical fibre** or **graded-index multimode optical fibre** is more suitable for very long-haul optical communication system.

[3 marks]

(b) Draw the **structures** and **refractive index profiles** for both step-index single mode optical fibre and graded-index multimode optical fibre. Label all the parts of the fibres clearly.

[4×2=8 marks]

(c) Explain to the client how an optical fibre can be produced by the plasma-activated chemical vapour deposition (PCVD) method.

[8 marks]

(d) What are the **THREE** advantages of PCVD method?

[6 marks]

Continued.....

Question 4

(a) Light losses in an optical fibre can be caused by the extrinsic material absorption losses, thus resulting in lower performance of the optical communication system.

(i) What is extrinsic material absorption loss?

[3 marks]

(ii) Give **TWO** suggestions to minimise extrinsic material absorption losses.

[3 marks]

(b) Discuss how hydrogen absorption in optical fibre affects performance of fibre and how to minimise it.

[8+3=11 marks]

(c) **Fig. 4(c)** shows a slotted core fibre cable structure. State the name and function of each component labelled as (i), (ii), (iii) and (iv) as shown in the **Fig. 4(c)**.

[4×2=8 marks]

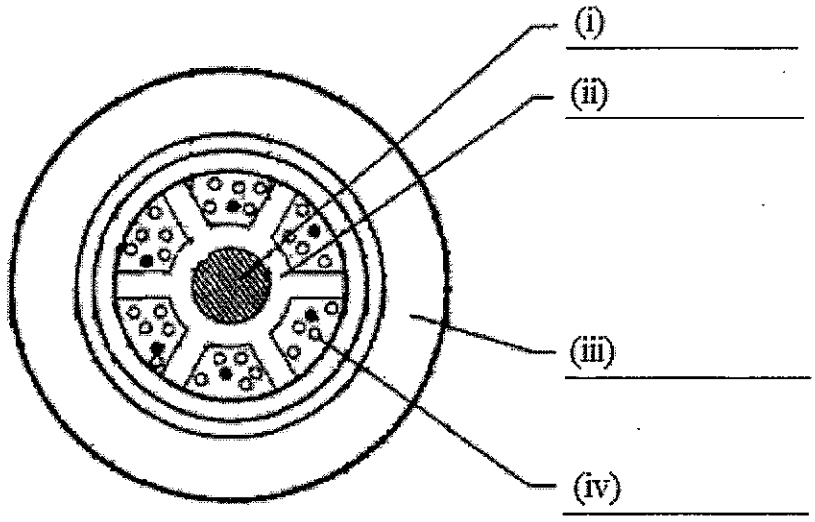


Fig. 4(c)

List of constant:-
Electronic charge, $e = 1.6 \times 10^{-19}$ C

End of Paper